Medical Library

Vol. VII. No. 3. April, 1930.

APR 28 1930

British Journal of Anæsthesia

Founded 1923 by the late Editor Dr. H. M. Cohen.

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MACHINES AND MEN.

The ever increasing tendency of machinery to preponderate in the affairs of mankind, which is probably the most noticeable feature of the modern world, is in no department of life more remarkable than it is in our speciality of anæsthetics. So much, indeed is this the fact, that one observer remarked that the anæsthetist of the future will not be a doctor clad in a sterile overall in the operating theatre, but an engineer in dungarees working oustide it. Here, with a vast machine that records respirations and heartbeats, blood-pressure and muscle tone and the rates of flow of liquids and gases and their pressures, he will sit with oilcan and spanner and regulate the wheels and cranks and cogs of his machinery, without eye or ear having direct cognizance of the patient who is being operated upon.

This is, of course, but a fanciful sketch and yet it is not in some ways very far removed from present truth. And the question at once suggests itself, is it altogether for the patient's good that the anæsthetist should become more of a mechanic and less of a medical man? Is there, in fact, any danger that by his increased attention to the mechanical side of his art, he will lose something of the medical side, and that by knowing so much more of the machinery that he uses, he will know proportionally less of the man on whom and for whose benefit it is being used? We confess to a certain apprehension that there is some foundation for these fears. This apprehension arises from observation of the young anæthetist of today as he matures. We notice and applaud his mechanical skill. We marvel at, and perhaps envy, his unrivalled assortment of tubes and taps and mechanical devices of various kinds, but we are, on the other hand, sometimes a little

shocked at the comparative inadequacy of his clinical acumen and observation. It does not cheer us to see him successfully carrying out a difficult and elaborate method of administration without realising that his patient has achieved a condition in which remedial measures are immediately necessary. We believe that it is still the patients' condition which should be the anæsthetist's first care, not the condition of his machinery.

Nobody, of course, can question the benefits which improved machinery have brought to the administration of anæsthetics. It is only through advances on the mechanical side that the wide and efficient use of nitrous oxide and oxygen has become possible, that intratracheal insufflation has become an everyday practice and that continuous level supplies of ether vapour can be given with ease. Have the terminal results been equally satisfactory? Can we, in fact, point to a greatly diminished mortality in anæsthesia? We believe that for the very fullest advantages to be reaped from our improved mechanical position, it is essential that the anæsthetist of the future should be even more skilled than was his predecessor in observing and estimating the condition of his patient both before, during, and after operation.

Many of our readers teach the administration of anæsthetics as well as practise it. To them we would point out that it is, in popular parlance, the man behind the gun who counts. It is no use perfecting the gun if we neglect in any respects the training of the man who is to fire it.

A CORRECTION.

In the list of Officers of the Anæsthetic Section of the Royal Society of Medicine given in our last number we accidentally put O.B.E. after the name of Dr. Lengton Hewer. He asks us to point out that this addition was incorrect.

SPINAL ANALGESIA—A NEW METHOD AND A NEW DRUG—PERCAINE.

By W. Howard Jones, M.B., B.S., (Lond.).

Surgeon Anæsthetist to Charing Cross Hospital; Senior Anæsthetist to the London Temperance Hospital, etc.

BY courtesy of the Clayton Aniline Co. I have been able to make trial of the new analgesic drug percaine, discovered by Karl Meischer and manufactured by the Society of Chemical Industry in Basle.

In America this drug will be known as "Nupercain."

Chemical Properties.

Percaine is the hydrochloride of α butyloxycinchoninic acid diethlyethylendiamide and has the formula:—

It belongs to a group of chemical combinations which up to now were unknown to possess analgesic properties.

It forms colourless crystals, odourless and tasteless; crystalizes at 90° and melts at 97°.

It is readily soluble in water and alcohol, and solutions have a neutral reaction.

Thus it does not belong to the same family as cocaine or novocaine, but is a derivative of quinoline and therefore related to quinine.

Re-distilled water must always be used for preparing solutions which may be boiled repeatedly without decomposition, but it is essential that no alkali should come in contact with it lest dangerous decomposition products should be formed.

In order to counteract any alkalinity derivable from glass containers 5 minims of dilute hydrochloric acid must be added to each litre of solution prepared.

It is a slight vaso-dilator but adrenaline may be added to solutions when cool, for tissue infiltration and nerve block.

Laboratory Tests and Clinical Results.

By laboratory tests percaine is proved to be ten times stronger than cocaine and twenty times stronger than Novocaine, and therefore far more toxic than either, but as toxicity is in great measure dependent upon concentration and percaine is effective in extreme dilution toxicity in practical use is reduced to such a level that symptoms are not produced.

In spite of this high dilution it is claimed that local analgesia can be obtained which exceeds in duration that hitherto obtained by any previously known drug.

In clinical applications by Hofer, Ritter, and Christ these remarkable properties have been demonstrated in the human subject and up to ten hours duration of analgesia has been recorded by them with a corresponding relief from post-operative pain.

The solutions recommended by them are:— 1-2000 for large infiltration, 1-1000 for nerve blocks, or for the latter purpose smaller quantities of 1-500.

From their experience they put the maximum amount of these solutions to be injected as follows:—

400 c.c. - - -	1-2000
150 c.c. - - -	1-1000
50 c.c. - - -	1-500

The maximum amount of solid drug to be injected is fixed provisionally at 0.2 Gramme.

Recommendations for spinal injections were 3-4 c.c. of 1-1000 solution but this was later abandoned in favour of 0.8 c.c. of 1-100.

Nothing much seems to have been done with this method and few details are given, and it is obvious nothing much could be expected from this dosage.

Before injecting percaine into the spine I felt that it was necessary to have first hand evidence that no tissue damage followed local tissue infiltration.

A few tests on minor operation cases were entirely satisfactory, and subsequently Mr. Norman Lake and Mr. Jennings Marshall adopted it for use in their clinics at Charing Cross Hospital.

Their conclusions in relation to local analgesia will be the subject of a separate communication.

I have myself used percaine in a few extensive infiltrations and no toxic effects either local or general followed its use.

The claims made for percaine therefore appear to be fully justified in relation to tissue infiltration both in regard to duration of analgesia and non-toxicity.

I have been able to show that the claims made, so far as spinal analgesia is concerned, have been much too modest.

My own interest in percaine centered chiefly in its application in spinal analgesia, for although novocaine is very certainly effective up to a point, it is notoriously disappointing in the duration of its action on account of the inherent defect in the usual method of administration by gravitational diffusion, which results in a diminishing concentration of novocaine from below upwards, and a tendency to affect the posterior roots more than the anterior, so that relaxation in the upper segments of the abdominal muscles is often imperfect in the later stages of an operation, and closure of the wound is difficult.

The prolonged action claimed for percaine promised a great improvement in this respect.

The Objective.

Spinal analgesia results either from an intra-dural caudal block, or in the dorsal region from a thoracic nerve root block.

The nerve trunks forming the cauda equina are equally

the most accessible and the most easily affected by an analgesic solution in the whole body.

They lie in relation to the point of a needle inserted through any of the lumbar inter-spaces.

The thoracic nerve roots are remote from the point of the needle and in the past have been reached by the following methods :—

1. Gravitational diffusion, resulting from the injection of a solution relatively heavier than the cerebro spinal fluid.

2. Barbotage or mixing the dose in the syringe with spinal fluid and the repeated withdrawal and re-injection of fluid. This is usually completed by gravitational diffusion.

3. Replacement of a large quantity of cerebro-spinal fluid withdrawn into a syringe containing the dose of drug. This is also usually completed by gravitational diffusion.

By way of contrast I propose to illustrate the effects ot gravitational diffusion.

If 10 or 15 cg. of novocaine contained in 1 or 1½ c.c, of 10 per cent solution in normal saline S.G. 1.023 is injected quietly between L1 and L2 it meets opposite the point of the needle a limited quantity of cerebro-spinal fluid and is at once reduced to a 5 per cent solution or less, and the S.G. is correspondingly lowered.

This is stage one, a powerful block of novocaine across the cauda equina resulting in an analgesia lasting anything up to two hours in the legs.

If barbotage is practised there is an immediate distribution of the novocaine and a great reduction of the concentration down perhaps as low as 1 per cent with a correspondingly great reduction of S.G. When after a quiet injection the body is placed in the immediate Trendelenberg position two processes operate, absorption and dilution, which bring about an automatic progressive reduction of the specific gravity, a progressive retardation in the rate of the descent and finally the remnant of the solution is so dilute and the S.G. so near that of the C.S.F. that the dose fizzles out at a level which is proportional to the amount of novocaine and sodium chloride injected.

Absorption is rapid into the blood as well as by nerve

tissue and as I shall prove to you shortly is the cause of a general novocaine toxæmia when large doses are used.

Effective dilution is compelled by the obstructions encountered by the solution in its downward path which act like the baffle plates in a mixing machine and set up eddies favourable to this process. It is even possible that the steeper the Trendelenberg position is the more effective does rapid dilution become on account of the greater tendency to the formation of vortex ring action resulting in a wider dissemination of the solution in the tube.

This result is well seen by dropping ink into a tall cylinder of water when both spread and retardation are obvious.

A heavy solution naturally tends to sag along the bottom of the tube and to affect the posterior roots more than the anterior, resulting in the development of higher sensory paralysis than motor, while the diminishing concentration of novocaine from below upward causes more and more imperfect results in the same direction. This explains the numbness in the skin area of C_2-C_3 without paralysis of the phrenic motor roots, and the imperfect relaxation of the upper segments of the rectus if the does has been too small.

There are two other positions:—

1. The sitting after a small dose of novocaine between L_4-L_5 to obtain a restricted sacral block, which is good practice.

2. The horizontal for hernias and sub-umbilical operations when the spread of novocaine is determined by the U-tube shape of the spine in this position, equality of level being reached in both lumbar and thoracic limbs of the tube.

With full doses of novocaine in this position very effective results are obtained for a prolonged period in the lower regions, and we are confronted with the apparent anomaly that the lower the injection is made into the spine the higher the novocaine should diffuse by gravity into the thoracic limb if the curve of the spine is normal, and L_4-L_5 is at a higher level than L_1-L_2.

In this classification I place Pitkin's light solution of spinocain.

Dr. Pitkin having no doubt heard that what Lancashire thinks to-day England will think to-morrow, took advantage of a favourable opportunity and cautiously by proxy, planted this mixture in generous soil at the annual meeting of the British Medical Association at Manchester.

I submit that there never has been and never can be, a small volume low specific gravity solution containing a sufficiently high percentage of novocaine, which when mixed with cerebro-spinal fluid in the sub-arachnoid space will behave in the manner suggested by Dr. Pitkin.

Let me for a moment rob Dr. Pitkin's solution of its heavy constituents and make it lighter still.

What is the result of adding 2 or 3 cubic centimetres of a low specific solution to a very much greater quantity of fluid of higher specific gravity? Very little. The specific gravity of the mixture will be very little under that of the large volume with which we started.

Now put back the heavy constituents novocaine and sodium chloride. The tendency to an increase of specific gravity by these heavy substances will far overbalance the tendency to a decrease by the small volume of low specific gravity fluid added with them.

Spinocain can only act as a floating solution as long as it is intact. Once mixture with a large amount of cerebro-spinal fluid has taken place the heavy constituents diffuse by gravity as they do after an injection of novocaine in saline solution. Probably the more rapid absorption of alcohol also tends to bring about this result.

All descriptions of clinical results which I have seen are characteristic of the preponderating posterior root effect and the diminishing concentration of novocaine from below upwards of the solutions spread by gravitational diffusion.

Dr. Pitkin himself states that "anæsthesia first presents itself in the perineal region, the legs, the lower abdomen and gradually ascends upward on the body surface. When it subsides it disappears in a reverse manner; anæsthesia may be maintained in the perineal region from two to two and a

half hours, in the upper abdomen it will not be satisfactory for more than an hour to one hour and a half."*

Here is a picture of the results of gravitational diffusion.

The Pitkin method as I see it is as follows:—

Dr. Pitkin invites his followers by withdrawing varying quantities of spinal fluid into a syringe containing spinocain to "expand" it to corresponding proportions thereby attaining different levels of analgesia.

This is the old method of "barbotage" under another name.

The victim is now provided with an instrument of precision called a tiltometer, and following instructions he places the patient's body at an angle favourable to the spread of novocaine by gravitational diffusion.

But lest the honest fellow should be worried by any fear that the novocaine will go to the head, he must now fix his mind very hard on the air bubble in a spirit level, and when done thoroughly of course anything may be seen.

The solution begins to form peculiar shapes, patterns of which have been provided beforehand with the outfit, and all sort of theories may be developed.

This also is an old method.

Dr. Floyd T. Romberger in "Current Researches in Anæsthesia and Analgesia" gives an account of Pitkin's work and has the use of all his plates and diagrams. He says:—

"Pitkin operating in a beautiful little gem of a hospital nestling cosily among the friendly trees of a green carpeted knoll in Teaneck, N.J., driving himself day after day and night after night into the wee small hours with seemingly inexhaustible energy, inspired by a brightly shining inner light to an almost superhuman effort, has evolved during the past two years a controllable type of spinal analgesia which has given a new impetus and a refreshened knowledge to this surgical problem.

His studies led him into the hydrodynamics of the spinal fluid and its circulation.

**Current Researches in Anæsthesia and Analgesia*, Vol. viii, No. 2, March/April, 1929.

His investigation entered into the realms of *Fluidity, Viscosity, Diffusion, Dissemination, Absorption, and Volume Control.* . . . He employed in all his different experiments among other things and methods 38 cadavers, 264 dogs, and 2,278 rats."* What search and research!

The nightly round-up followed next day by painstaking spinal injections . . . where have the results of these important experiments been published and to what conclusions have they led?

It is known from published results that in the Trendelenberg position spinocain sometimes finds its way inadvertently into the neck, Dr. Pitkin also states that in the sitting position spinocain injected in the lumbar region can be recovered in the neck within between 9 and 11 seconds, and gives an illustration showing this experiment being performed. This instance of a reversal of the natural forces can only be parralleled by that accorded to Moses and his followers, when faced by a predicament hardly greater than that in which the Teaneck school now finds itself . . . for I think I can show you that the characteristic result of a genuine light injection, is, in the dorsal decubitus a preponderating anterior root block.

There have been no disastrous consequences as the result of percaine injections.

On the contrary the condition of the patient on the operating table shows a very marked improvement over the results obtained with novocain and stovaine, and 7½ milligrammes of percaine will give a longer analgesia than 150 millligrammes of novocaine.

Any method which depends upon the withdrawal of definite quantities of cerebro-spinal fluid is necessarily uncertain, for it is not always possible to withdraw the desired amount especially if a fine needle is used.

A New Method.

The method which I propose to advocate, is that of treating the subarachnoid space in the same manner as the tissues,

**Current Reseaches in Anæsthesia and Analgesia,* Vol. viii, No. 6, November/December, 1929.

by the forcible injection of a large quantity of analgesic solution to the limit required by the operation. No cerebro-spinal fluid is withdrawn. I believe I am reporting the results of the first series of over a hundred cases treated in this manner.

A system of dosage has been arrived at by the simple method of injecting a series of consecutive cases with increasing quantities of solution and recording the levels reached.

Extreme accuracy is not essential, the requirement for a complete block of the splanchnic communications is that the solution should pass the roots of D5, but that it must not reach as far as the cervical roots, more especially the roots of C4 the main origin of the phrenic nerves.

A satisfactory level to reach is D2 or D3.

The first time that 15 c.c. were injected a complete splanchnic block with perfect relaxation resulted.

Before describing the administration in detail it is necessary to examine the conditions which determine success or failure.

The Cerebro-spinal Fluid.

The Cerebro-spinal fluid is, according to authority, secreted by the choroid plexuses, and in the perivascular spaces found in relationship with the vessels of the pia mater. Its movements within the cranium do not concern us, and most evidence points to the fact that there is no measurable circulation within the subarachnoid space of the cord, any slow movement which may take place being probably towards the caudal end of the dural sac throughout which absorption takes place.

More than twenty years of experiment by the injection of analgesic drugs within the theca has demonstrated nothing to combat this belief, though those who write upon this subject appear to be ignorant of this evidence.

The amount of cerebro-spinal fluid has been variously estimated to be between 60 and 150 c.c.

Professor Pannett[1] reviewing spinal analgesia in a Hunterian Lecture last year, described experiments made with a dural sac dissected from the vertebræ complete with

its contents, and estimated the amount of fluid from C6 down to be 30 c.c.

In a later paper he advances the theory that the dural sac is not capable of distension, but the evidence which I shall put before you does not, I believe, support that conclusion.

The rate of absorption of injected fluids from the subarachnoid space is rapid as also is that of foreign chemical substances.

Duret introduced 580 c.c. of water in the dog within two hours.

Naunyn and Schreiber 400 c.c. of normal saline in a dog 9½ kilos in an hour and three-quarters using 100 mm. Hg. pressure. Falkenheim and Naunyn showed that the absorption is rapid even at low pressure.

The absorption of fluid and foreign chemical substances is mainly into the blood vessels rather than by the lymphatics.

The specific gravity varies within fairly wide limits and the following table by Levinson[2] shows a variation between 1.001. and 1.010.

Hoppe	1.001	1.005
Halliburton	1.007	1.008
Kazka	1.002	1.008
Zdareck	1.007	
Polanyi	1.005	1.007
Mestrezat	1.007	
Nawratzat	1.008	
Penda	1.007	1.010
Borrelli and Data	1.007	1.009
Williamson	1.005	1.009
Hammerstein	1.007	1.008
Eskuchen	1.006	1.007
Levinson	1.003	1.007

Starling gives - - 1.005

A recent case of hydrocephalus at Charing Cross Hospital was 1.008.

This variation in the specific gravity of the cerebro-

spinal fluid is the most important thing to recognize and remember when using the method under consideration.

The pressure varies also, but is about 10 or 11 mm. Hg. and 150 mm. water.

Percaine Solutions.

The strength of percaine solutions most suitable for spinal injections are 1-1000, 1-1500, 1-2000 for large volume injections, while 1-500, and even 1-100 in very small quantity may be used for simple caudal block.

As it is inconvenient and unnecessary to keep a large number of different strengths, I shall deal for the present with the first three high dilutions.

For the first time in the history of spinal anæsthesia a drug is available, which is potent in such extreme dilution that the weight dissolved adds next to nothing to the specific gravity of the vehicle. Percaine solutions in the above high dilutions may therefore be regarded for practical purposes as being of the same specific gravity as the salt solution in which it is dissolved, and thus low specific gravity solutions may very easily be made by reducing the amount of sodium chloride below the content of normal saline.

The two types which I have used are :—

Normal saline 0.9 per cent; and 0.5 per cent saline

Specific Gravity of Percaine Solutions.

The following table of specific gravities has very kindly been estimated for me by Mr. Norman Evers, Chief Chemist to Messrs. Allen & Hanbury, the author of a recent work on drug testing.

These figures come from an authority.

At 35.5 Centigrade.

	1-1000	1-1500	1-2000
Percaine in water - -	1.0001	1.00005	1.00005
Percaine in 0.5 % Sodium chloride - -	1.0035	1.00345	1.00345
Percaine in 0.9% Sodium chloride - -	1.0062	1.0061	1.0061

From this table it will be seen that only the most delicate methods are capable of detecting any rise in specific gravity due to percaine dissolved in water in these high dilutions.

I am very much indebted to Mr. Evers for his help.

I shall use the terms hyper- iso- and hypo-baric, to describe solutions which have specific gravities greater than, equal to, or less than that of the cerebro-spinal fluid.

Comparison of Percaine Solutions with Cerebro-spinal Fluid.

Bearing in mind the very important variation in the specific gravity of the cerebro-spinal fluid, and comparing percaine solutions with it, it is evident that the normal saline solutions in all high dilutions may prove to be hyper-, iso-, or hypo-baric, and that they frequently will be hypo-baric.

The 0.5 per cent saline solution will almost certainly be hypo-baric and is also hypo-tonic.

The difference between the specific gravities will, however, especially in the case of normal saline solutions be extremely small, and even the 0.5 per cent saline solutions will not have a difference comparable to that of the old novocaine and stovaine solutions.

The Behaviour of a Hyper-baric Solution.

In the event of a normal saline solution proving to be hyper-baric to the cerebro-spinal fiuid the danger of a spread by gravity in the high Trendelenberg position depends upon whether a large or small volume has been injected.

The effect of the injection is to create immediately a long or short column of fluid within the dura.

After a small injection the danger of a spread is negligible, but when a large injection has created a long column of percaine solution reaching as high as the second or third dorsal roots, even if the specific gravity is only slightly higher than the cerebro-spinal fluid, and the difference may have been averaged by mixture, if only the least bias is left an inconvenient spread may take place.

The following case is illustrative.

A man, aged 63, under Mr. James McClure in the London Temperance Hospital, one of the earliest cases in this series,

was given an injection of 15 cubic centimetres of 1-1000 percaine normal saline solution. S.G. 1.006.

After proving the paralysis of the abdominal muscles and a skin level of about the third thoracic he was taken into the theatre and placed too early in the Trendelenberg position.

During the process of exploring the right ureter, he announced that he was losing the use of his arms.

He did in fact develop a paralysis of his arms and forearms, retaining some power in the shoulder muscles.

He had a block of his sixth cervical roots resulting from a spread of four or five segments.

There was no stone in the ureter, but there were several in the gall bladder, and this was removed.

Though he had a severe fall of blood pressure the pulse was all the time very easily palpable in the temporal artery.

The operation was not interrupted for a moment, and he made a rapid recovery free from after effects.

The collapse was nothing like so severe as that seen after large doses of novocaine.

In order to avoid such an occurrence either a hypo-baric solution must be used or a sufficient time must elapse for sodium chloride to be absorbed, for it must be remembered that the percaine itself is not the important factor producing the hyper-baric character of the solution.

The Behaviour of Iso-baric Solutions.

If a normal saline solution happens to be iso-baric it will of course stay in the region into which it is put until absorption takes place, although it is possible that there may be a small general sag of cerebro-spinal fluid towards the head when the Trendelenberg position is adopted.

It is impossible at present to know that a solution will be iso-baric in any particular case.

The Behaviour of Hypo-baric Solutions.

Attention has already been drawn to the fact that on account of the variation in the specific gravity of the spinal fluid the normal saline solutions S.G. 1.006 frequently prove to be in this class. The 0.5 per cent saline solutions almost certainly will be.

Preponderating anterior root block.

Using this method of direct injection with hypo-baric solutions I have for the first time been able to observe the remarkable result which is characteristic of their action in the dorsal decubitus and the cause of many failures to develop analgesia.

The condition which results in the dorsal decubitus is a predoninating anterior root block with little or no effect on the posterior roots; thus the entire abdominal musculature may be paralysed and yet the patient will be in an inoperable condition unless a general anæsthetic is given.

This effect is also recognizable when towards the end of a long operation the patient may begin to experience pain which will continue to result from manipulations until the end, but the abdominal muscles will remain paralysed and unable to respond to painful stimuli, closure of the wound being completed without difficulty. Another demonstration of this effect is the intense peristalsis often amounting to severe spasm in which the colon in parts may be reduced to the size of a finger, and intestinal movement is greatly exaggerated. This is due to the more effective paralysis of the efferent inhibitory fibres of the splanchnics contained in the anterior roots.

All this results in spite of the fact that sensory nerve fibres are more easily affected than motor.

It is thus evident that the percaine solution has applied itself in greater concentration to the anterior roots than to the posterior roots. This preponderating anterior root effect is a striking contrast to the preponderating posterior root effect of the heavy small volume injections of novocaine and stovaine spread by gravitational diffusion and shows a reversal of results.

The first time I was able to recognize anterior root block was in a case under Mr. James McClure in the London Temperance Hospital, which has already been reported in the *Lancet*.

A man, aged 62, the subject of a carcinoma of the colon was given an injection of 15 cubic centimetres of 1-1000 percaine in normal saline between L1 and L2 and a profound

splanchnic block developed. Re-section of the terminal portion of the ileum, caecum, and part of the ascending colon, was performed followed by a lateral anastomosis. After one hour fifteen minutes during the arrangement of the anastomosis the patient complained of pain and was in obvious distress. He was offered gas but fortunately he said he would endure the pain if we were not going to be long.

This pain continued on manipulation until the end, but there was no accompanying rigidity and after twenty minutes the closure of the abdomen was effected without difficulty.

Mr. McClure agreed with me that a preponderating anterior root effect was the only possible explanation of this condition.

The cause of past failures to develop analgesia now became obvious and cases were remembered such as that of a man the subject of a colostomy who, though paralysed in the abdominal muscles and unable to raise his thorax off the table, could not have endured his operation if he had not been very stoical.

This condition in various grades has since been frequently seen and is now easily recognizable.

Another effect of a hypo-baric solution is illustrated in the case of a man under the care of Mr. Norman Lake at Charing Cross Hospital. After an injection of 15 c.c. of percaine solution he was left too long in the lateral position and when placed on the operating table his abdomen was asymmetrical, the right side which was lower during the injection was flat and the muscles were contracted, and the left or upper side was paralysed and bulging.

During the course of the next ten minutes the paralysis spread to the right side.

The lesson to be learned from these cases is that as even the normal saline solutions' S.G. 1.006 may in any case be hypo-baric, all patients who are the subjects of percaine injections must first be placed in the ventral decubitus in order to soak the posterior roots and develop analgesia, and when they are finally put in the dorsal, paralysis of the anterior roots will naturally follow and will probably outlast the anlgesia if the time allowance on the posterior roots has been too short. *(To be continued.)*

THE SELECTION OF CASES FOR AVERTIN ANÆSTHESIA.

By Sir Francis Shipway, K.C.V.O., M.D.
Senior Anæsthetist, Guy's Hospital.

EVER since the introduction of general anæsthesia man has been reluctant to entrust his conscious self to the hands of another: however trusty his guide, he hesitates to make the journey into the darkness, as so many have failed to return. This is a natural and almost universal attitude of mind. The few, the very few, who profess a liking for the loss of self-control, the discomfort, the confused and bewildering dreams and sensations which uually accompany the onset of anæsthetic unconsciousness are to be classed as abnormal. "De gustibus non disputandum," but one's experience has led one to believe that this curious mental outlook is confined almost exclusively to women and in connection with the alministration of chloroform, and to conclude that the basis of these emotions is erotic. But many patients are literally terrified at the prospect of an anæsthetic: they fear the anæsthetic, not the operation, although the question may well be asked whether their reasoning is justified. Whatever the answer, there is no doubt that they find it difficult to "screw up their courage to face the ordeal," to use the expression of a very intelligent woman. This is particularly true of the fanciful neurotic patient who leads a luxurious existence and endeavours to avoid the unpleasant facts of life, or the only child who has never been taught self-control. It is well known also, that a nervous element enters very largely into the causation of retching and vomiting; it is for this reason that medical students and nurses and those who have been connected with the surroundings of the operating theatre do not make ideal subjects for anæsthesia, whilst mental exhaustion and domestic worries are predisposing causes of a stormy recovery. I am convinced also that there exists a certain

type of woman, luckily rare, who attempts by adopting a pose of complete misery and by repeated retching to gain the sympathy and even notoriety to which neither her character nor natural talents entitle her. Nor is it only the surrender of the conscious self which is abhorrent to the normal individual. Equally disliked is the return from profound anæsthesia with its alternating periods of nightmare and reality, of confusion and clearness.

Avertin is invaluable for all these patients. It is given to the patient in bed, making the outward journey rapid and free from discomfort, and the return smooth and natural, whilst the reactions of the nerve-centres to the stimuli of the operation are on an entirely different and easily controllable plane. Moreover, the attitude towards anæsthesia entirely changes. It is no longer looked upon with such fear and loathing.

The introduction of anæsthetic drugs by the intravenous route presents advantages, many difficulties and some dangers and has been in this country abandoned; by the rectal route, many advantages, no difficulties, and no danger if properly controlled. Of the drugs commonly employed in this manner, ether in olive-oil, paraldehyde, avertin, there is no doubt, in the experience of the writer, that except for children under the age of six, for whom Dr. H. Sington's[1] paraldehyde technique is to be preferred, avertin most nearly approaches the ideal anæsthetic. He believes that its administration has been placed upon a sound basis; he hopes that its use will steadily increase. It is with this object that notes of types of cases which seem to be peculiarly suitable for its exhibition are given, together with comments. The writer is also indebted to Mr. O. Gayer Morgan, Assistant Opthalmic surgeon, Guy's Hospital, for a short account of its use in his Department.

Case No. 1. Woman, aged 52, who had suffered from trigeminal neuralgia for many months, was admitted into hospital for injection of the Gasserian ganglion with alcohol. She was in a highly nervous condition and dreaded the idea of a general anæsthetic. Avertin was recommended. Her weight was 10 st. 3 lb., pulse-rate 76, respiration-rate 20, systolic blood-pressure 130 mm. Hg. She was given morph.

sulph. gr. $\frac{1}{6}$, scopol. hydrobrom. gr. $^1/_{150}$. As she was the first patient to whom avertin had been given and the recommended dosage at that time was higher than it is now, she was given half-an-hour later, that is 2.30 p.m., a dose of .15 gr. per kilo body-weight (9.75 gr.); 2.50, semi-conscious, P.R. 120, R. 20, B.P. 118, brought up to anæthetizing room. 3.0; unconscious, eyes fixed, corneal reflex brisk, P.R. 88, R. 17, B.P. 120. 3.10; P.R. 80, R. 14, B.P. 120; operation begun, penetration of skin not felt, groaned and moved arms and legs gently when bone touched. Duration of operation 10 minutes. Slept for 5 hours. Remembered leaving ward for operation, but nothing after that.

As relief was not obtained from the injection of alcohol it was repeated a week later. The same preliminary injection of morph-scopolamine was given but the dose of avertin was reduced to .1 gr. per kilo body-wegiht (6.5 gr.) as the patient's apprehensions had been allayed by her previous experience. Half-an-hour later, anæsthesia was of medium depth, respiration 14, pulse-rate 80, blood pressure 105 mm. Hg.: later, pulse rate fell to 68. The same phenomena were observed during three attempts to inject the ganglion as on the previous occasion. Final attempt successful; the patient slept for $4\frac{1}{2}$ hours, awakening as before refreshed, without nausea or headache. Eighteen months later she was re-admitted owing to a return of the pain, and asked to be given avertin for the operation. The same technique was used as on the second occasion; the same phenomena were repeated. Injection was more difficult and took 25 minutes. Recovery as before. Avertin is an excellent anæsthetic for this operation if the patient is to be rendered unconscious.

Another type for which it seems to be strongly indicated is that of the patient suffering from chronic osteomyelitis of the long bones who has to undergo several operations. The dread of another anæsthetic, the retching and vomiting both before and during induction, whatever method of anæsthesia is used, and the severe vomiting which often follows, make a clinical picture which is recognised at once: moreover the patient is toxæmic. Even a preliminary injection of morphia the dose of which may have to be minimal on account of the youth of the patient, seems to have little effect either in pro-

viding mental calm or in preventing post-anæsthetic vomiting, in fact it appears in some cases to increase the tendency to vomiting. The following three cases illustrate these points.

Case No. 7. Female aged 15. Chronic osteomyelitis left tibia, right femur. Previous anæsthetics very frightened; weight 4 st. 12 lb.. Morph-sulph. gr. $^1/_8$, atrop. sulph. gr $^1/_{150}$, avertin 3.1 g. Unconscious, but lightly under. Ether 4½ ounces. Operation 40 minutes; no vomiting.

Case No. 53. Boy aged 12. Chronic osteomyelitis tibia; weight 5 st. 4 lb. Atrop. sulph. gr. $^1/_{100}$, avertin 3.3 g. Anæsthesia light. Gas and oxygen for 54 mins.; no vomiting.

Case No. 113. Boy aged 17. Chronic osteomyelitis tibia; weight 6 st. 8 lb., morph. sulph. gr. ⅙, atrop. sulph. gr. $^1/_{100}$, avertin 3.9 g. Anæsthesia light. Slept for 2½ hours; vomiting severe. Fortnight later, leg amputated; very anxious to have avertin. Morph. and atrop. as before; avertin 4.1 g.; well under. Gas and oxygen for 35 minutes. Slept for 6 hours; much retching.

In each of these cases the patient was delighted with avertin and although the last patient suffered much from retching he was perfectly satisfied, as he had been spared the anticipation and discomfort of induction by a general anæsthetic.

Paraldehyde is altogether too disgusting a drug for a sensitive and fastidious patient. The injection is painful, and the odour often makes the recovery unpleasant to the patient and a trial to the nurse. Moreover, the period of sleep is very prolonged. One young woman who had to be anæsthetised on three occasions at short intervals was given paraldehyde on one of them and disliked it intensely. She had been sent into a nursing-home for acute antral suppuration. She gave a history of various operations, not connected with the nose, and expressed a violent horror of and aversion to anæsthetics. She was emotional, with an unstable nervous system, and was thought to be a drug-addict. In view of the short time for preparation, she was ordered morph. sulph. gr. ⅙, atrop. sulph. gr. $^1/_{100}$ and anæsthetized with gas-oxygen-ether. She struggled and vomited during induction, was difficult to handle and excited and noisy during recovery A few weeks later, when a more extensive nasal operation had to

be performed, paraldehyde (3vii) was given. She complained of pain during the injection, then fell asleep and was soon unconscious. Anæsthesia was maintained without difficulty with ether. Consciousness was regained some hours later and prolonged vomiting followed, due, according to her, to the smell of paraldehyde. Relief was obtained for a time from this second operation but the temperature rose again and intraorbital pain became so severe that it was decided after consultation with a neurologist to explore the wound and to inject the nerve with alcohol. Morphia and other sedatives had been used freely. The mental and physical condition were poor. For this third operation morph. gr. $\frac{1}{6}$, atrop. gr. $^1/_{100}$ and avertin .1 g, per kilo body-weight were given, followed by ether. The operation lasted 70 minutes; recovery was quiet and free from vomiting.

Basil Hughes[2] welcomes avertin for children for whom "it banishes the dread of the anæsthetic mask and the surroundings of the operating theatre." I have notes of the case of a boy aged 12 in whom it proved of the greatest possible value. He had to have his appendix removed and both his father and himself were panic-stricken at the thought of an anæsthetic, for one of the family had, a few months before, died during an operation under peculiarly distressing circumstances. Their great anxiety was relieved, however, to some extent on reading in the daily press an abstract of an article on avertin which had recently appeared in a medical journal. At their request it was agreed to use avertin for the induction of anæsthesia. Accordingly morph. sulph. gr. $\frac{1}{6}$, atrop. sulph. gr. $^1/_{100}$ were given followed by avertin .1 g. per kilo body-weight (3.9 g.): half-an-hour after injection the boy was very sleepy and was easily anæsthetised with gas and oxygen and a little ether. An excellent recovery followed, It is of interest to note, as showing his extreme fear, that even these quantities of morphia and avertin—somewhat heroic for a boy of 12 years—were not sufficient to produce complete unconsciousness. When questioned the day after the operation he said that "he just remembered being given the gas." Complete amnesia occurs in the great majority of patients although there may have been some talking or muttering before the general anæsthetic is administered. In a few, a

general anæsthetic is not necessary. The factor which in my opinion has the greatest influence in determining the depth of anæsthesia by avertin is the temperament of the patient.

Case No. 65. Girl, aged 16; exophthalmic goitre. Pulse-rate 140; apex beat ½ inch external to nipple line; weight 9 st. 10 lb.; morph. sulph. gr. $\frac{1}{6}$, scopol. hyd. gr. $^1/_{150}$ avertin at 0.1 g.=6.1 g.; unconscious; gas and oxygen.

Case No. 107. Woman, aged 46 (matron of a hospital); long history of exophthalmic goitre; tonsillectomy recommended by physician. Very anxious about anæsthetic; morph. sulph. gr. $\frac{1}{6}$, scopol. hyd. gr. $^1/_{150}$; avertin 5 g. weight 8 st. 9 lb.) given 1 hour before appointed time for operation. Well under; ether; slept for 2 hours. Very delighted with method.

Case No. 75. Male, aged 47. Pulmonary tuberculosis both apices, and anal fistula; weight 9 st. Morph. sulph. gr. $\frac{1}{6}$, scopol. hyd. gr. $^1/_{150}$; avertin 5.79 g.; no anæsthetic needed.

Case No. 128. Woman, aged 43. Abdominal hysterectomy under ether some weeks previously at another hospital; vomiting for five days. Large ventral hernia. Admitted to Guy's under Mr. F. T. Steward for repair: he suggested avertin in order to prevent vomiting; weight 10 st. 3 lb. Given morph. sulph. gr. $\frac{1}{6}$, atrop. sulph. gr. $^1/_{100}$, avertin 6.5 g. Deep anæsthesia, corneal reflex just present, pupil small, reacting to light. Airway inserted, gas and oxygen. Repair with living sutures taken from fascia lata of thigh. Duration of anæsthesia 1 hour 45 minutes. Vomited once.

Avertin has also been found valuable for such operations as gastrostomy and œsophagoscopy. In all cases in which a supplementary general anæsthetic such as ether has to be used the amount of this can be very considerably reduced. Axertin is not given if the renal function is poor, and the dose is diminished in old people.

REFERENCES.

1. Proc. Roy. Soc. Med. 1929, xxii, 5. p 29.
2. Lancet 1929, p 1221.

ADDENDUM

By O. G. Morgan, F.R.C.S.

For some time avertin anæsthesia has been used by me more or less as a routine in the Ophthalmic Department at Guy's Hospital. Children and one or two elderly patients with some renal deficiency, have been excluded. Atropin sulph. $^1/_{100}$ and morphine hydrochlor. $\frac{1}{4}$ are injected beforehand, and the dose of avertin has varied in adults from 0.06 to 0.08 gm. per kilo according to the nature of the operation. The results have been extremely satisfactory, especially where a local anæsthetic has been added.

For intraocular operations cocaine is instilled into the conjunctival sac; for removal of the eye this is reinforced by a retrobulbar injection of novocaine and the smaller dose of avertin is given. For removal of the lacrymal sac, muscle operations, or plastics on the lids, a small injection of novocaine is ample to keep the patient perfectly quiet. If the larger dose of avertin is given, the local anæsthetic is usually unnecessary. Occasionally the patient has moved or remarked sleepily about pain, or the eye, but in all cases there has been complete amnesia.

The method is extremely satisfactory for urgent intraocular operations on an acutely inflamed eye.

The operator has plenty of room in which to work, plenty of time, and there is none of the increased venous engorgement which one gets with a general anæsthetic, and which makes the operation so much more difficult. Several cataract extractions have been performed under avertin, but the patient's control of his own eye is of such enormous advantage to the operator, that I would only use avertin in these operations in the case of an extremely nervous individual.

During the operation an airway was usually inserted, and none of the patients seemed to resent this. There was, as a rule, some cyanosis of the face and lips, shallow breathing alternating with intervals of deep breathing due to the morphine, but the pulse kept full and slow, and never gave cause for any anxiety.

There was post-operative vomiting in one case only; others waking up slowly and quietly, and putting no strain on the operated eye.

RATIONALISATION OF ANÆSTHETIC APPARATUS.

By R. J. Clausen, M.B., B.S.

THE word "Rationalization" which has had such prominence in the Press of late may well be used to describe a reform which I feel to be necessary in the anæsthetic equipment of the teaching and other Hospitals, which often attains an extraordinary degree of complexity and redundancy.

For example, it is by no means uncommon to find in a well-equipped operating theatre the following :—

(1) Anæsthetic trolley with stock bottles and equipment for ordinary open and closed methods, and possibly a Junker bottle with hand bellows.

(2) Sight feed Gas and Oxygen machine with bottles for Ether and Chloroform vapour, tube, bag, etc.

(3) Oxygen cylinder on stand.

(4) Foot operated cylinders of gas with bag, etc.

(5) Carbon Dioxide cylinder or sparklet.

(6) Vapour apparatus, e.g. Shipway's.

(7) Endotracheal vapour apparatus.

(8) Electrical suction and pressure pump, which may have Ether bottle attached.

(9) A liberal supply of rubber tubing, connections, etc. to join up the various units.

All this occupies much space, and the necessity for frequent assembling of apparatus not only takes considerable time and trouble but provides a constant source of danger from mis-connection.

The effects of this system, or lack of system, are seen in a teaching hospital where two Resident Anæsthetists are

occupied for a considerable time before the arrival of the Honorary in assembling the apparatus for his use, while examples of complicated apparatus are provided by a gas and oxygen machine which includes fourteen pieces of rubber tubing between cylinders and patient, any one of which may kink or perish and so put the whole out of action, and a vapour apparatus for Chloroform and Ether, which only comprises two anæsthetic bottles but possesses no less than eight separate taps and controls, not including a drain tap for the water jacket, a mercury blow-off a spring ditto, and four pieces of rubber tube.

It has for long seemed absurd that a Gas and Oxygen machine was not incorporated in a trolley, forming a complete unit, since the ordinary sight-feed variety is not sufficiently complicated to justify its existence as a separate apparatus.

The trolley outlined below was designed for the Ear, Nose, and Throat theatre of a general Hospital, but for various reasons it was not adopted; I believe, however, that such a trolley would effect a great saving in time and trouble for all concerned, would occupy less space and possibly cost less than the various units it would replace.

It would measure over all about 40 in. by 24 in., the main frame measuring 28 by 18, the feet being well splayed out to give steadiness. A clear table top about 24 by 12 would be provided, below which could be drawers or shelf for stowage space. At the bottom would be a compartment for motor and pumps, with the controls mounted on the front.

On the right would be a 40 ft. oxygen, held in a clamp, and a 200 gal. Gas and 2 lb. Carbon Dioxide, held in yokes. Behind, and above the top, a central sight feed bottle with distributing tap and Ether and Chloroform bottles with control taps. On the left, two or three suction bottles.

All piping on the machine would be permanent in metal, and placed away from damage. The only rubber tubes would be that leading to the patient and one connecting the oxygen cylinder to the sight-feed.

The glass bottles would be "Kilner" jars supplied commercially and easily replaceable; two sizes only used. They

would hang from their lids which would be attached to a substantial frame, space being allowed below for their easy removal; a water jacket could be arranged below.

All cylinders would have reducing valves and fine control taps.

The motor would be of adequate power to drive two pumps, for suction and pressure, with perhaps fast and loose pulleys to allow one only to be used. The pumps proposed are of a commercial make, of rotary type, of solid construction and silent in use. They would be enclosed for silence and safety together with all electrical parts in a stout wood box, but accessible from above and behind for adjustment, oiling, etc.

In the lead from each pump would be a two-way tap controlled from the front, giving a graduated flow from zero to the full output of the pump. The pressure delivery would be led to the exit from the sight-feed, passing through the same Ether and Chloroform controls as the gas, etc.

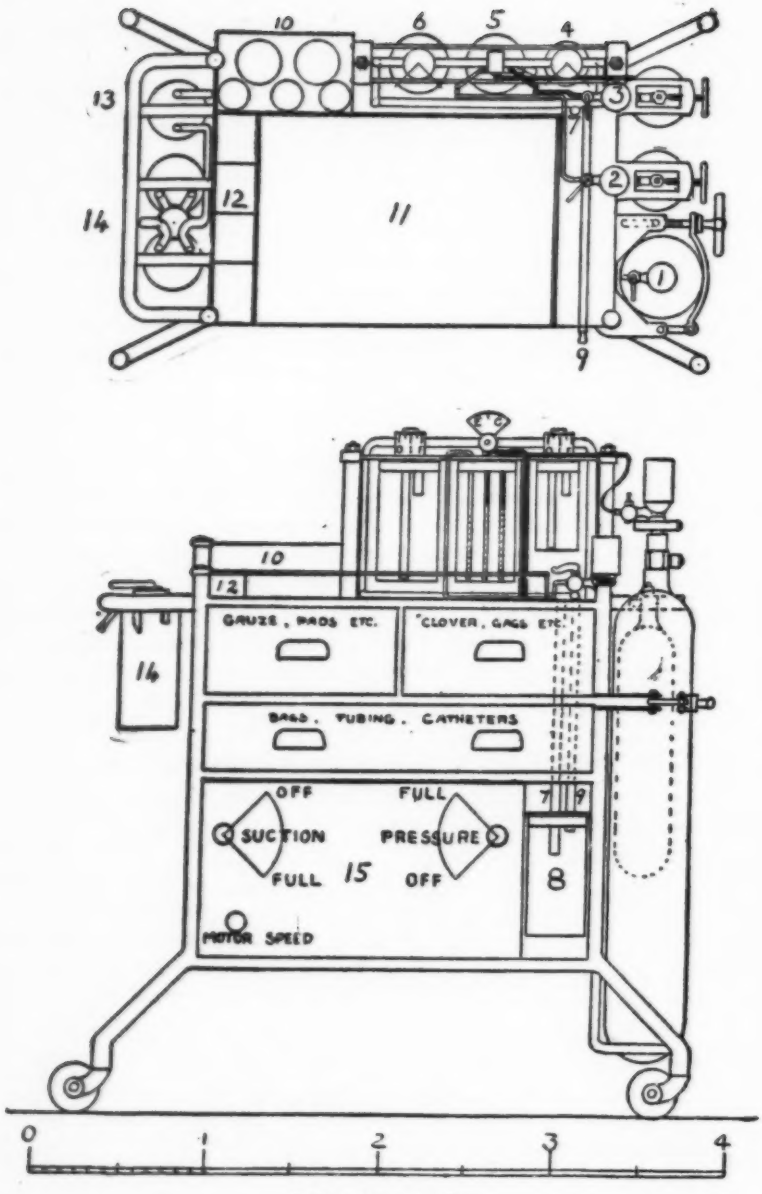
A gauze filter would be between the pump and sight-feed, and a trap bottle on the main delivery pipe before it leaves the machine, to prevent water, etc. being blown over.

At least two suction bottle would be fitted, with change-over tap to enable one to run while the other is emptied; a third might be added in series as a trap before the pump.

At the main exit pipe would be a Pressure Gauge, spring blow-off, and perhaps a flow-meter; a heater could be added if desirable.

Such a machine would provide a complete outfit for all forms of Inhalation Anæsthesia as now practised in the form of one mobile unit which would require a minimum of attention and upkeep, and would offer many advantages over the heterogenous collections now to be seen in our theatres.

It would not correspond to any now recognised type of machine, but the simple and unmistakable nature of its controls would enable it to be readily used by any administrator. By dispensing with the Pumps, etc. the whole could, of course, be made more simple, compact, and cheap.


10
6
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4
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9
10
12
GAUZE, PADS ETC.
CLOVER, GAGS ETC.
14
BAGS, TUBING, CATHETERS
OFF
FULL
7
9
SUCTION
PRESSURE
FULL
15
OFF
8
MOTOR SPEED
0
1
2
3
4

SCALE: FEET

REFERENCES TO DIAGRAMS.

1, 2 and 3. Oxygen, nitrous oxide and carbon dioxide cylinders with reducing valve and fine control tap.
4. Chloroform bottle with control tap.
5. Triple sight feed, with distributing tap.
6. Ether bottle with control tap.
7. Common exit pipe from bottles 4 and 5.
8. Trap bottle to prevent accidental blowing over of liquid.
9. Exit pipe from machine.
10. Rack for stock bottles.
11. Free table top.
12. Trays for small kit.
13. Trap bottle for sucker.
14. Twin suction bottles with change-over tap.
15. Front of motor and pump box with controls, motor and pumps are totally enclosed, but accessible from behind or above for repair, oiling, etc. Pressure side of pump is lead through filter (not shown) to exit from sight feed bottle, thence proceeds as gas, etc.

Controls operate two-way taps, giving graduated output with positive cut-off, but no load on motor when "off."

Output of pumps ensures ventilation of box.

Motor speed controlled by sliding rheostat and pull-out knob, or however convenient.

Separate pumps for suction and pressure, circuits not connected.

Pressure gauge and blow-off on exit pipe on top deck, not shown.

A tap on exit from sight-feed would provide connection for foot or hand bellows, for emergency use.

THE PSYCHOLOGY OF INDUCTION IN ANÆSTHESIA.

By NORMAN W. RAWLINGS, L.M.S.S.A. (London).
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IT has been said that it is "sometimes well to emphasize the obvious"!—for that reason I pen the following comments:—

It is a far cry since the days when the producing of unconsciousness totally lacked psychology and was merely brutal, such as pressing the carotid artery, (carotid="the artery of sleep") or by other traumatic means bringing about a merciful syncope.

In modern days psychology has a definite place in the administration of anæsthetics. The anæsthetic is an incident to the anæsthetist but an epoch-marking event to the patient. Patients, as a rule, do not fear an operation, but they do frequently dread the anæsthetic:—"giving up their consciousness," "entering the unknown," "wondering if the surgeon will begin his duties too soon!" or, "shall I come round" Dr. Dudley Wilmot Buxton states, "It is not a mere figure of speech to speak of 'dying of fright'."

As distinct from his skill, the mentality and attitude of the anæsthetist are of the greatest importance. It is an advantage if he is personally known to the patient, and it is therefore wise to try to see a case before the time of operation. We have all seen the quiet, gentle type of anæsthetist engendering confidence and hope in a patient. Equally acquainted are we with the blustering pre-historic cave-man, "You for it" variety, shocking his patient and disorganising the team work in any theatre. There has been seen and heard (fortunately rarely) the over-confident anæsthetist who walks about the theatre, returns to his patient, administers an anæsthetic douche and then resumes his ambulatory

route. Lastly, the "know-all" who resents the kindly and helpful suggestions of the surgeon or of anybody else. To a patient in whom anæsthesia is being induced, noise and movement around him become exaggerated or are actually "painful" as a 'victim' expressed it. The banging of doors, shutting or opening of windows, the clank of instruments being emptied into a tray, footsteps in the theatre, the loud blowing of nasal organs, or the quoting of the latest "Limerick" (often as old as the hills!) may all be described as adventitious sounds which are genuine disturbances to any patient whether nervous or otherwise.

The dumping of sterilised ironmongery upon a patient's epigastrium before induction is complete, or the willing assistant whose effort in controlling a fractious semi-anæsthetized person resembles that of a rugby scrum, are not exactly pacific factors relative to induction.

In the scheme of things pertaining to the introduction of anæsthesia, the anæsthetising room has its status. It should be peaceful, warm, light, not gaudy in decoration, such as a fiery red colour or icteric in appearance, and devoid of oak panels—the latter being to a failing consciousness too suggestive of brass fittings and a bunch of flowers! Severe terror, before or during induction, is definitely harmful and prejudices recovery. Therefore an attempt should be made to induce a placid and philosophical temperament as well as anæsthesia. This can be greatly aided by a tactful Ward Sister or Nurse, or by creating an atmosphere of the "matter-of-course" routine of a Surgical Ward or efficient Nursing Home. It is not good to overdo the pre-operative preparation of a patient. Insure a good night's rest beforehand by giving drugs, if thought advisable, and discuss topics more cheerful than surgery.

Avoid all unnecessary fuss or delay in the passage from bed to the commencement of the anæsthetic.

Give the patient instructions as regards breathing, indeed give him something to think about, and DO.

See that his position upon the table is as comfortable as circumstances permit. Some patients like to hold the hand of a nurse or other attendant during induction.

Hearing is the last sense to be lost, therefore be sure that unconsciousness is established before making any medical or personal remarks.

The anæsthetist's aim in the psychology of induction is to control fear, to diminish if he can, better still to abolish, that frequently-present "certainty" in the patient's mind that consciousness will not return.

Fear is infectious—from a patient, via the anæsthetist even to the surgeon and his theatre staff. If it were not so, team work would become more mechanical than human, and confusion in emergency increased. The potential loss of a patient, followed by a necessary interview with a Coroner, and a possible unwanted advertisement in the Press—become very real.

It is a high ideal to attempt to eradicate fear in a child to such an extent that memory will not cause it to dread a possible second anæsthetic in later life, or in an adult in the case of a two-stage operation.

We are all familiar with expressions of anxiety—just before and during induction—such as: a child crying lustily for its mother, the woman calling upon the Diety for help, the old man disjointedly muttering about his manhood days, the soldier with his canteen phraseology. (sui generis).

To a thoughtless anæsthetist these expressions are simply, and nothing more than, a collection of well-worn gramophone records!

The statement has been made that induction begins at the moment of decision for operative interference. Certain it is that such a decision, for most people, "hits you where you live" as the Americans define it.

The advice to undergo a general anæsthetic is too often misconstrued as request to make a will or put a house in order. Even at this stage an anæsthetist can be helpful by taking upon himself what might be termed a psychological power of attorney and advocating sleep in place of finality. Obviously again, pathology and shock sometimes win the day, but even in these cases perhaps a peaceful induction may lead to a Euthanasia much more to be desired than life wrecked by some of Nature's degenerations. We know something of the interaction of pathology and anæsthesia,

but "psychic shock" still remains elusive as regards its true interpretation. The obvious things and the apparently simple are not always easy to practise. Experience, skill, and psychology together do not guarantee a fear-free induction, but their employmnet does much to rob the backwaters of Lethe of many terrors: their employment gives the Surgeon opportunity to perform his art with the minimum of concern, and the anæsthetist the privilege of guarding those who sleep.

THE ANÆSTHETIC EQUIPMENT FOR THE NEW SURGICAL BLOCK AT ST. BARTHOLOMEW'S HOSPITAL

By Edmund G. Boyle, O.B.E., M.R.C.S., L.R.C.P.
(*Senior Anæthetist to St. Bartholomew's Hospital*).

and G. Wellesley (*of Coxeter and Son*).

IN the new surgical block that is being erected at St. Bartholomew's Hospital, there are five floors, with a male and female ward on each floor. On each floor there is also an operating theatre, anæsthetic room, surgeons' room, dressers' room, sterilizing room, etc.

For many years past it has been an ideal of mine that gas oxygen etc. should be laid on to every theatre, and now at long last it looks as though my dream is about to come true, for in each of the five theatres, N_2O, Oxygen, and CO_2 are delivered, not only into the Anæsthetic room, but also into the theatres themselves. Mr. George Wellesley, of Coxeters, has dealt with the mechanical side of the matter in the latter part of this contribution and it remains for me to give the Anæsthetic view.

In each of the anæsthetizing rooms will be a set of four bottles, one as a water sight feed for CO_2, the next a sight feed for gas and oxygen, the next for chloroform, and the fourth for ether; these will be connected to cylinders in the basement, so that gas, oxygen or CO_2 can be turned on at will, and as required.

When the patient has been anæsthetised in the anæsthetic room, the rubber tube connecting the rebreathing bag to the apparatus can be detached, the patient wheeled into the theatre, and the tube re-connected to a similar apparatus, which is placed on a pedastal or stand in the theatre. Thus there will be no wheeling in of apparatus or cylinders on the theatre floor.

The arrangements that mave been made to ensure a constant supply of gases are very ingenious, and should work perfectly.

When this installation is in working order, we believe that it will be the first of its kind in the British Empire.

The following is an outline of the scheme for distributing nitrous oxide, oxygen, CO_2 and air at plus and minus pressure through pipes to the five new operating theatres and five anæsthetising rooms at St. Bartholomew's Hospital. A sixth pipe is laid which could be used for ethylene, acetylene or any other anæsthetic gas. The cylinders and compressor and vacuum pumps will be in a room by themselves on the ground floor.

The question of how to distribute the gases is not quite as straightforward as it sounds, owing to the falling off of pressure in a length of pipe and the importance of preventing variations of the flow in one theatre causing a fluctuation in another. It would be most inconvenient if the anæsthetist had to be perpetually adjusting his valves in order to maintain a constant flow, and it must be remembered that the flow past an ordinary fine adjustment valve is not only dependent upon the aperture but also upon the difference of pressure on either side of it.

There is, however, a wide variation of pressure at our command; that is to say, from about 800 lb. per square inch (which is the vapour pressure of N_2O at room temperature) down to say 50 mm. of mercury (about 1 lb. per spuare inch). After considerable calculation and some practical experiment we came to the conclusion that the most satisfactory plan would be to drop the pressure twice with pressure reducing valves and a third time with a fine adjustment valve.

The first pressure reducing valve will be screwed directly to the cylinder valve to drop the pressure to about 50 lb. per square inch and this, except for the natural drop caused by friction in the pipes, will be the pressure maintained in the main piping.

At each outlet in the theatres and anæsthetic rooms there will be a second pressure reducing valve to drop this pressure to about 10 lb. per square inch, to supply each individual

anæsthetic apparatus, and this pressure should be completely unaffected by what is happening in other theatres.

A pressure of 10 lb. per square inch is a very reasonable one to have in a light flexible tube, so that the fine adjustment valves can be mounted above the water sight feed bottles on a set of Boyle's gas-oxygen-CO_2-chloroform and ether bottles, and permit the set of bottles to be moved about within the limit set by the length of the flexible tubes.

The air at plus pressure is controlled in a very similar way, and the difficulty of preventing one theatre which is

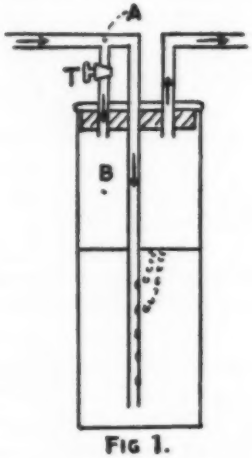

FIG 1.

sucking air, from robbing the other theatres of their vacuum, is overcome by using a vacuum pump of generous capacity and fitting a fixed restriction in each individual suction tube on the pump side of the trap bottles.

Two or three other modifications to the Boyle's bottles have also been incorporated.

The first is a by-pass tap, "T," from the N_2O inlet tube of the N_2O sight feed bottle to by-pass the water (see Fig. 1). When this tap is shut the rate of flow can be estimated in the ordinary way, and when the tap is opened, a second range of higher flow can also be estimated. Furthermore, the

second range is considerably wider (as it requires to be) than the first, for the following reason.

The flow past the tap "T" is dependent upon the difference of pressure on either side of it, say at the point 'A' and the point 'B.' Now the difference of pressure at these two points is indicated by the difference in the level of the water inside and outside the sight feed tube, and the level inside can be judged by observing the number of holes bubbling. A chart showing the rates of flow over both ranges in litres per minute is supplied with each set of bottles.

Fig. 1 is merely a theoretical diagram and bears no resemblance to the bottles themselves, but it will readily be seen that by this arrangement we get the effect of a sight feed jar two or three feet high in the space of an ordinary sight feed bottle.

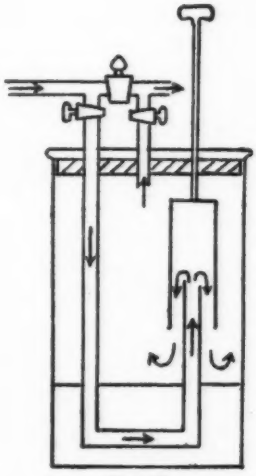

FIG 2.

Fig. 2 is the theoretical diagram of the chloroform and ether bottles. In practice the three taps are of course combined in one and actuated by one lever which can be finely graduated from by-pass to chloroform or by-pass to ether as the case may be.

The modification is in the upturned inlet tube with its movable cap.

After the full volume of N_2O and O_2 has been made to enter the bottle, the concentration can be still further increased as gradually as the anæsthetist likes, by slowly lowering the cap so that the gases are impinged upon the surface of the liquid anæsthetic more and more closely regardless of the depth of the liquid. As soon as the lower margin of the cap is submerged in the liquid the gases are forced to bubble up through it.

ABSTRACTS.

Percain, the newest substitute for cocaine. Deutsch. Med. Wochft., February, 14, 1930.

H. Richter summarises his conclusions as follows :—

1. Percain in two per cent watery solution is at least as effective a surface anæsthetic as 10 per cent cocain.
2. It does not irritate the tissues.
3. It is stable in watery solution.
4. It combines well with adrenalin and gives as good an ischæmia then as cocain.
5. It penetrates as easily and quickly as cocain.
6. The analgesia lasts longer than with cocain.
7. It is not inferior to novocain as an infiltration anæsthetic.

The physiological basis of avertin anæsthesia. W. SEBENING, in *Schmerz Narkose Anæsthesie,* February 15, 1930.

The author sets out, by means of both clinical and experimental observations to answer these questions :

1. Where and in what manner is absorption of avertin carried out after rectal administration.
2. What factors determine the blood concentration and what is the relation between this and the narcotic effect.
3. How is the narcotic distributed among the tissues.

The principle of the method of investigation adopted depended on the estimation of the bromine in the avertin molecule after this had been subjected to saponification and titration. Avertin was obtained from the organs by extraction into ether which is made easy by the ready solubility of avertin in ether. Investigating twenty patients of various ages by means of X-ray photography the author found that the injection of avertin reached various positions in the large intestine but never entered the small. In two cases the whole of the large bowel including the cæcum showed the presence of avertin. Individual anatomical differences in muscular tone and in gaseous and other contents apparently account for the different heights to which the injection ascends. The amounts of avertin that were recoverable from the rectum by forcible pressure also varied; from 10 c.c. to 175 c.c. 40 minutes after injection of 300 c.c. The absorption was obviously rapid from the large bowel in all cases in the first thirty minutes. The highest blood concentration was reached within the first 20 to 30 minutes. The peak concentrations were 5 to 9.5 mgr. per cent. With concentrations

under 4 mg. there was no deep sleep. After the maximum concentration had been reached there is a decline, the rapidity of which depends on the narcotic capacity of the individual. With septic and cachectic individuals the duration of the narcosis is longer than with others. Investigation into the distribution of avertin among the tissues showed that organs richest in lipoid retain the largest amounts and that the brain stood out as easily first.

Prof. B. Martin (*Schmerz Narkose- Anæsthesie*, Nov. 15, 1929) corroborates the opinion as to the rapid absorption of avertin from the rectum, and states that until the percentage has fallen to 1¼ the avertin is absorbed faster than the water in which it is dissolved. He points out, however, that he has attained with a one per cent solution in some patients exactly the same results as in others with two per cent. He believes that the absorption of avertin, therefore, is independent of the strength of concentration. The narcotic effect, however, is dependent upon the rapidity with which the drug reaches the tissues. He records acase in which the avertin solution had an unmistakable odour and the patient's breath, when she was anæsthetized, reproduced this odour strongly. Martin speaks well of the combined use of magnesium sulphate, avertin and narcophin.

Distribution of the blood in shock. L. Blalock and H. Bradburn *Archives of Surgery*, January, 1930.

The authors start with the thesis that in shock without hæmorrhage diminution of the blood volume is attributed to passage of fluid from the blood into the tissues. The harmful results of diminution of the blood volume are attributed to reduction of the oxygen supply to the tissues. If reduction in the oxygen supply of the tissues is an important factor in the pathogenesis of shock then it would seem that information of value might be obtained from a study of the oxygen content of venous blood in various portions of the body. This was the study undertaken. Dogs were used in all the experiments. Barbital was employed as the anæsthetic. 0.3 gr. per kilogram of bodyweight was injected into the external jugular vein. Ninety-seven series of determinations were carried out. Some of the conclusions arrived at were : the oxygen content of blood from the portal vein was much higher relatively after trauma to the intestines while that of blood from the extremities and head was low; the oxygen content of blood from the femoral vein of a traumatized leg was high, while that of blood from the opposite extremity and head was low. The oxygen content of blood from the renal vein was relativelyr high in all the experiments. The observations suggest a local accumulation of blood at the site of trauma to a large area such as the intestinal tract or an extremity, and are evidence against the action of a histamine-like substance that produces a general bodily effect.

Spinal anæsthesia: Criticisms of the Pitkin method. E. FALKINER HILL, W. HOWARD JONES, and F. E. SHIPWAY. *Lancet*, Jtnuary 18 and 25, 1930.

Falkiner Hill values the Pitkin method for its safety. He states that it gives little control over the duration of the anæsthesia, less over its height and practically none over the blood pressure. From clinical evidence he believes that the anæsthetic sometimes affects the cord as well as the posterior roots, and that the anæsthesia passes off not only from above downwards, as is maintained, but also from below upwards. The strychnine in Pitkin's fluid should be omitted, it does no good and may render the cord highly excitable. Shipway points out that the fear of putting the patient into the Trendelenburg position after intrathecal injection of a heavy solution is entirely groundless. The anæsthetic agent is rapidly fixed and control over the height of analgesia quickly lost. Howard Jones holds that Pitkin's method is based on fallacious reasoning. He believes that the level of analgesia reached depends entirely on the amount of the dose injected. With a heavy solution the posterior roots are always more affected than the higher, with a solution of less specific gravity than that of the cerebro-spinal fluid the converse is true.

Post-operative pulmonary complications. C. T. FULLER, M. D. *Lancet*, January 18, 1930.

The article is based on an analysis of 1,478 operations with 124 instances of pulmonary complications. Seventy-five of these were bronchopneumonia. The author concludes that there were three main conditions necessary for the production of a post-operative pneumonia.

1. The presence of organisms in the lungs, either before the operation or aspirated during the period of unconsciousness at operation or soon afterwards.

2. The inhibition of the respiratory movements and in particular those of the diaphragm consequent on the surgical procedure.

3. The lowering of the patient's reslstance.

Fuller maintains that greater attention should be paid to the examination of the chest for evidence of inflammation of the respiratory tract and a closer inquiry made into the history of recent coughs and colds. During the first two or three days after operation the patient should be encouraged to move himself as much as circumstances will permit and to practise taking deep inspirations.

SECTION OF ANÆSTHETICS.

(Royal Society of Medicine.)

A discussion on anæsthesia in rectal surgery was opened on December 6th, 1929 by Dr. J. K. Hasler. Dealing with the surgery of rectal cancer the speaker said that when a preliminary colostomy was performed he preferred a geenral anæsthetic for the operation. For the subsequent eradication he preferred a spinal anæsthesia in combination with some form of twilight sleep or a light general anæsthesia. Injection between the third and fourth lumbar spines caused anæsthesia well above the umbilicus. Spinal anæsthesia did not always obviate chest complications. For perineal operations, for hæmorrhage, fissuse etc. a very deep anæsthesia was advisable before the operation began. In cases of fistula it was not always desirable to produce full relaxation of the sphincters as the surgeon often wished to be able to feel the sphincter during operation. Local anæsthetics, especially spinal ones, relaxed the sphincters too much.

Mr.E. T. C. Milligan preferred "gas-oxygen" with preliminary sedatives for rapid and simple perineal operations, but low spinal anæsthesia limited to the sacral nerves was also valuable in these cases. Post-operative pain bore no relation to the method of anæsthesia.

Dr. Howard Jones believed that percaine would be very valuable for rectal operations. He described the intraspinal use of a one-twentieth solution. For producing complete splanchnic block 15 c.c. were injected without withdrawing cerebro-spinal fluid, and the solution would travel as high as the third or second dorsal vertebra.

The President (Mr. R. E. Apperly) commended the practice in abdominal-perineal excisions of the rectum of doing the perineal portion of the operation before the adbominal.

ANÆSTHESIA IN THORACIC SURGERY.

February 7th, 1930.)

Mr. C. Langton Hewer alluded first to preparation of the patient. He believed that the simple process of directing patients to drink as much fluid as they conveniently could between meals for two or three daye before operation made a great difference to their condition afterwards. He supposed the toxins liberated during the injury to tissues were diluted by this previous fluid intake and therefore had less effect on the nervous and circulatory systems For most adult patients a hypnotic beforehand was desirable and a fairly healthy man should have morphia gr. ¼ and hyoscine gr. $^1/_{100}$, but for a woman morphia gr. ⅙ was enough. As regards after-treatment he recommended rectal saline, 1 litre with 5 per cent glucose, at a

temperature of 115°F., to be run in while the chest wall was being closed. Great attention to warmth must be paid, preferably by means of electric cradle or electrically heated blankets.

The subjects for thoracic operations are usually in poor condition, suffering from phthisis, empyema etc. or other complaints which depress health apart from the local lesion. The chest-wall is muscular and extensive operations entail much oozing. Proceedings which involve opening one or both pleural cavities introduce disturbance of the normal relations of the thoracic viscera; serious respiratory obstruction may arise from pressure of tumours on air-passages, or from the presence of blood or pus within their lumen. Consequently for thoracic surgery a type of anæsthesia is needed which :—

1. Must have no depressant effect on the body as a whole.
2. Must have no harmful effect on normal or diseased lung tissue and must not increase the secretions of the respiratory passages.
3. Must not abolish the coughing reflex.
4. Must be followed by rapid recovery.
5. Must enable one or both pleural cavities to be opened without danger.
6. Must ensure adequate oxygenation of the blood even when normal respiration is obstructed.

Local anæsthesia, in the form of infiltration and paravertebral dorsal block, has a useful place in thoracic surgery. After-pain, however, is greater than with geenral anæsthesia, especially when the intercostal nerves have been blocked. The coughing reflex is not abolished but the effectiveness of coughing is diminished for some time after intercostal block. Phrenicotomy, drainage of plural and pericardial effusions, induction of artificial pneumothorax and rib re-section for acute empyema can often be conveniently performed under infiltration anæsthesia in adult patients. For extensive operations local analgesia has disadvantages, depending on dangers of toxæmia and of injecting into a vein. Moreover, local anæsthesia provides no guard against respiratory obstruction, or against collapse of the lung when the chest is opened. It is inadvisable with young children.

Chloroform is useful for inducing anæsthesia in patients suffering from a high degree of respiratory obstruction.

Ether is often useful when given by the open method to children too small for nitrous oxide and oxygen.

Rectal anæsthetics give a period of post-operative depressed or absent cough reflex which is undesirable in thoracic cases.

Nitrous Oxide and Oxygen has many advantages for thoracic surgery. It is non-irritating, does not abolish the cough reflex and is quickly recovered from. Given under pressure it permits of the opening of one or both cavities without dyspnœa. The adoption of

"gas-oxygen" has done more than any other one thing to render thoracic operations safe.

Ethylene and oxygen, which he had used in 130 cases, Dr. Hewer condemned for its smell and explosibility.

Thoracic operations may be classified as :—

1. Superficial operations on the chest wall.
2. Extrapleural operations involving the whole thickness of the wall.
3. Operations which involve the opening of one pleural cavity.
4. Extensive thoracotomies which may involve the opening of both pleural cavities simultaneously.
5. Intra-pulmonary operations.
6. Operations when a bronchial fistula is present.
7. Operations in the presence of some obstruction to the respiratory passages.

The commonest example of group one is operation for breast carcinoma which needs no special comment.

In the second group the usual operation is thoracoplasty. The chief difficulty here is due to the lateral position, to shock attending the stripping of the periosteum, hæmorrhage and in bronchiectasis, the continual expectoration of mucopus. Nitrous oxide and oxygen is the best anæsthetic to use. The patient should lean over and cough up all loose sputum before starting to inhale. If shock is getting excessive the surgeon should be informed, for the operation can be completed at a second occasion, which is one of the saving graces of these operations. In the last 100 cases of this kind done under gas and oxygen there was one post-operative death. The patient was in poor condition with chronic empyema and collapsed about 20 hours after operation. Probably too much was done at one sitting.

When œsophageal carcinoma is treated with radiation or by incision the approach is usually from the back. If the double endotracheal tube is used it is rare for there to be difficulties. Gauze should be tightly plugged round the tubes above the glottis.

Operations involving the opening of one pleural cavity cause collapse of the lung on that side and dyspnœa. The mediastinum moves towardrs the unopened side, tending to collapse that lung also. A considerable muscular effort is needed to draw enough air into the sound lung, and the lateral movement of the mediastinum always causes a certain amount of shock. If the pleural cavity is full of fluid under pressure, this spurts out when the cavity is opened, the intra-pleural pressure falls and the lung on this side will tend to expand and the mediastinum to be displaced towards the opened side. The undesirable effect arising from pressure changes can be modified by allowing the patient to breathe gases

at a pressure higher than that of the atmosphere. This may be achieved in three ways :—

1. By using the double-airway endotracheal method with a spring-loaded expiratory valve on the return tube.

2. By using the re-breathing intubation method introduced by Magill and Rowbotham.

3. The simplest method is to modify the usual nitrous oxide and oxygen technique by using a thicker rubber bag (gauge 8 instead of 10), a spring-loaded expiratory valve, and an anemometer or pressure gauge. With an intermittent-flow machine no alteration is required to get pressures up to 10 mm. Hg. which are usually sufficient.

Differential pressure should always be employed in thoracotomies while the pleural cavity is open, the pressure being so adjusted that the lung lies just below the surface of the wound. Before beginning the anæsthesia the patient should be settled in that position in which he breathes most easily.

For extensive thoracotomies which may necessitate opening both pleural cavities differential pressure is essential.

In intra-pulmonary operations, generally for draining an abscess or removing a foreign body, the cough reflex must not be abolished. The facepiece must be directed downwards so that blood coughed up is expelled through the expiratory valve.

When foreign bodies are removed from the lung on the X-ray table the anæsthetist has one of his hardest tasks. A hooded electric bulb illuminating the mixture control of the "gas and oxygen" machine, feeling the blast from the expiratory valve with the hand and a finger on the temporal artery are the best means for estimating the patient's condition and the supply of gases.

When a *bronchial fistula* is present and the surgeon prefers to plug it with gauze dipped in fluid, the coughing reflex must on no accgount be abolished. Any cauterisation of a fistulous tract precludes the use of ether or ethylene.

When *obstruction of the respiratory passages is present* the patient is placed in the position in which he feels most easy and full anæsthesia is then induced by chloroform. Then two stiff catheters are pushed down the trachea past the obstruction and anæsthesia maintained with nitrous oxide oxygen, and ether if necessary. It may be necessary to pass the catheters through the nose by touch, it not being possible to insert a laryngoscope.

Mr. I. W. Magill regarded major thoracic operations as falling into two groups : (1) more or less superficial operations, thoracoplasty, decortication or treatment of bronchial fistula for example. The patients in this group are usually in poor condition. They are subject to frequent coughing to clear the lungs and in many of them the visceral pleura is partly or completely adherent to the chest-wall and operation will cause no respiratory embarrassment. In this group positive pressure anæsthesia is not essential.

The second group includes operations for mediastinal and intrapulmonary tumours and cysts, diaphragmatic hernia, excision of œsophagus and some retrosternal goitres. The method of approach entails opening at least one pleural cavity and as the pleura is usually quite free pneumothorax is complete. Removal of the growth is accompanied by traction on structures in the mediastinum and shock may be severe. There is also the possibility of hæmorrhage from large vessels or of the opening of a bronchus. Obviously these patients need every possible protection. One useful measure is the induction of pneumothorax when possible some time before operation, enabling the patient to adjust himself to this condition. The opening of the chest at the operation then causes no shock or alteration in the respiratory mechanism. In many of the patients of this group positive pressure anæsthesia is essential.

Cases of *lobectomy* fall between these two groups—in them it may be neecssary to change from one method of anæsthesia to another as occasion arises.

Nitrous oxide and oxygen administered through a facepiece, not by intubation, Mr. Magill regarded as the anæsthetic of choice for patients in the first group. In the second group intratracheal insufflation is of the greatest value. He prefers to insufflate at as low a pressure as suffices to abolish the tracheal deadspace and to control expiration either by a wide bore return tube, or by using only one wide bore tube with an adjustable expiratory valve. A small amount of ether is generally advisable in addition to the "gas and oxygen." Mr. Magill related cases illustrating his opinions. His summary was :—

1. Local anæsthesia for minor operations.

2. Nitrous oxide and oxygen combined with intercostal nerve-block for major operations in which the pleura is adherent or not to be opened.

3. Endotracheal insufflation for cases where traction on the mediastinum is likely to interfere with efficient pulmonary ventilation. The anæsthetist should be prepared to intubate at a moment's notice, but the wider his experience becomes the less frequently does the necessity arise.

Mr. Tudor Edwards said that the whole question of anæsthesia in thoracic operations depends on whether they are carried out with a free pleura or whether the pleura is unopened or adherent. In the former case some method of positive pressure is essential, and in the latter "gas oxygen" is the anæsthetic of choice. Thoracoplasty for bronchiectasis and tuberculosis differs from the same operation for chronic empyema. In the latter when the cavity is opened there is no interference with the mechanism of respiration.

Dr. Z. Mennell put in a plea for light chloroform anæsthesia in many cases of empyema, especially when the operation was performed with the patient in a bed.

REVIEWS.

"Anæsthesia and Anæsthetics." F. S. Rood, M.B., B.S. (Dublin), H. N. Webber, M.A., B.Chir. (Cantab.), Anæsthetists, University College Hospital. Cassels; pp. 292; price 14/-; with 60 illustrations.

In their new book Rood and Webber have, we think, succeeded admirably in their objects of providing a useful guide to the untaught or inexperienced anæsthetist and of interesting their fellow anæsthetists in the methods they have adopted and use at University College Hospital. They have been faced with the task of steering a middle course between the giving of long descriptions of common methods and simple pieces of apparatus on the one hand, and the discussion of abstruse physiological points and peculiar difficulties on the other. This cannot have been easy and it is on their success in producing a book of such general interest that the authors are particularly to be congratulated.

The two points which the authors stress most are, of course, the necessity for keeping to ether whenever possible, and maintaining adequate ventilation of the lungs. From this they immediately infer that the open method of giving ether is the one to be chosen. In their description of a "typical ether case," however, the method used can hardly be considered as more than "semi-open." The necessity of careful control of the airway and the need for having oxygen at hand during any administration are the next points. The latter is often not sufficiently recognised and there are still theatres in London hospitals where asking for an oxygen cylinder is looked upon as a signal of distress or as an exhibition of undue fussiness.

CE mixtures and sequences find no place in the authors' routine at all. They admit that good results are obtainable by the use of mixtures for induction, but do not recommend them. It is perfectly true that strong mixtures, such as C_2E_3, are to be looked upon as chloroform and that the ether is merely a diluent which helps to make application to the mask mechanically easier. There are, however, many anæsthetists who use dilutions of one part of chloroform in eight, sixteen or thirty-two of ether and who find these inductions are much easier than with ether alone, whilst their patients are more comfortable. We think that the young anæsthetist who may have difficulty in a pure ether induction should be given the chance to use these dilute and practically safe mixtures rather than be left to struggle indefinitely or be panicked into sudden and injudicious use of chloroform.

In view of the general agreement that strong CE mixtures are to

be looked upon as chloroform pure and simple, and considering the popularity of the CE ether sequence, it is somewhat startling to come across the bald and unsupported statement that "induction with chloroform and maintenance with ether is extremely rarely advisable." Our own experience has shown few cases where it has been inadvisable.

There is one school in London where pure chloroform induction is used as a preliminary to the passing of a catheter for air-ether insufflation. Here we must admit there was often a period of extreme doubt and anxiety before the establishment of a regular pulse and respiration. The authors find that in cases such as tonsillectomies, chloroform maintenance can safely and satisfactorily follow an ether induction

In their discussion of the more special methods of administration the authors stress the need for relying as little as possible on mechanical aids. None the less we are surprised that in their recommendation of ether with oxygen in addition, they do not mention Mennell's bottle, a simple apparatus by which oxygen can be given with varying quantities of ether. Rectal anæsthetics are barely mentioned and although avertin has a footnote, paraldehyde which now has a definite place in the anæsthetist's pharmacopeia, has no reference at all. We feel that a further description of gas-oxygen in intratracheal anæsthesia would have been an advantage, for this mixture is probably the commonest medium of insufflation. The existence of the increasingly popular McKesson and and Heidbrink machines is not noticed, which is a pity, for if machines are to be used at all it is better to have those which are most easily worked and controlled.

The section on nitrous-oxide anæsthesia is conspicuous by three facts: that the young anæsthetist is not warned of the danger of erotic excitement in the patient; that the diagram of the valves of the Hewitt machine when arranged for re-breathing does not seem to fit in with the two previous diagrams; and that a young man is shown being submitted to a gas administration whilst still wearing a tightly-pinned collar.

The chapter on spinal anæsthesia covers the main points of the simple lumbar injection, and in these days of individual methods and drugs and dosages it is impossible to discuss the subject at all completely in one short section of a general review of anæsthetics

The practical and concise directions in the section on local and regional anæsthesia are of great value and are a welcome change from the usual vagueness in discussion of this part of the work.

Rood and Webber have given us a book which will be of great value to the anæsthetic clerk and the junior anæsthetist and which, by arousing interest and admiration, will act as a refreshing stimulus to their brethren of the drop-bottle.

G. A.

JUL 23 1930